



Advance Techniques for Inspection of Materials and Structures

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Sciences Branch

Introduction of NDE Technologies at NASA Langley Research Center



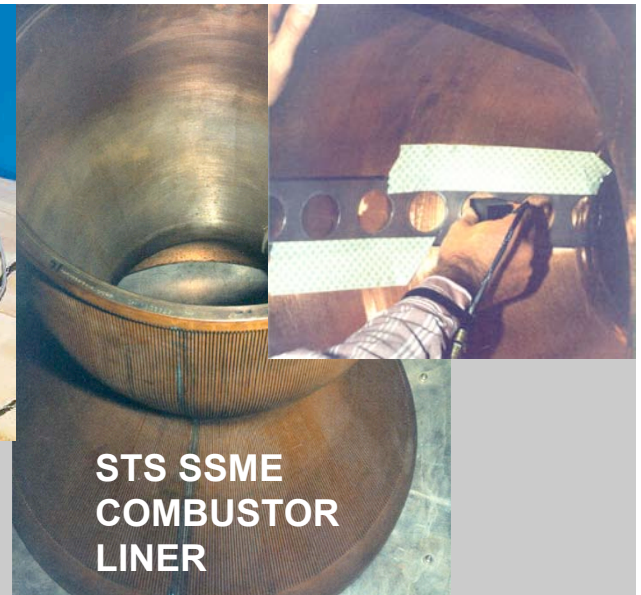
- 1980s - Aeronautics / Shuttle
 - Ultrasonics/Nonlinear Acoustics
Composites
Technology Transfer (primarily medical applications)
 - Thermography
Solid Rocket Motors
Composites
 - Fiber optics
Health Monitoring
- 1990s - Aeronautics
 - Eddy Current
Aging aircraft fuselage
 - Radiography
Aging aircraft fuselage
- 2000s - Shuttle/Aeronautics/Exploration
 - Terahertz
Shuttle
 - Wireless Sensor
Health Monitoring



**STS SRB
COMPOSITE
NOZZLE**

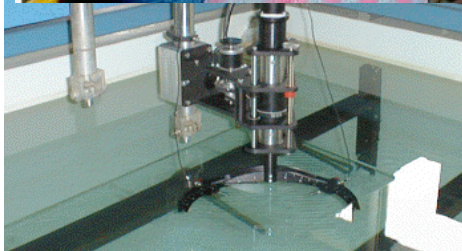


Eddy Current

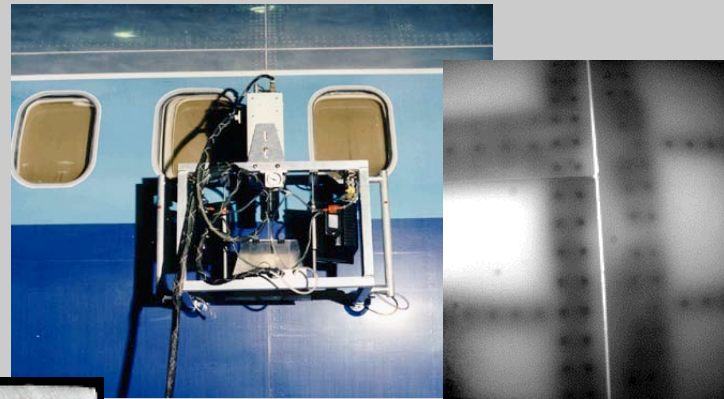


**STS SSME
COMBUSTOR
LINER**

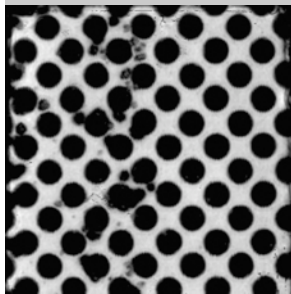
Advancing NDE Technologies for Complex Structures



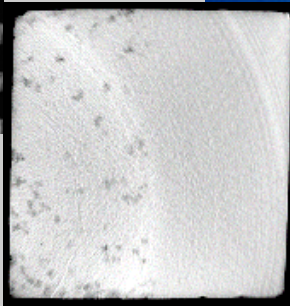
Ultrasonics



**B-757
FUSELAGE**



**Orbiter
Cold Plate
Corrosion**



Computed Tomography

Thermal



Manipulator Arm System

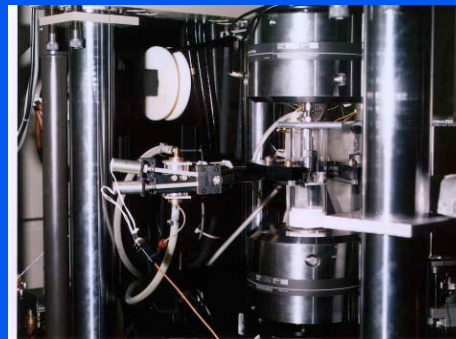
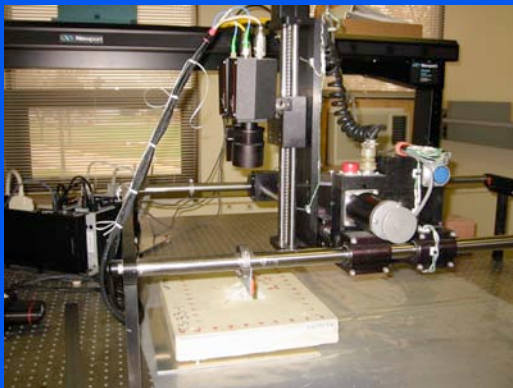
Thermal Imaging



Carbon Nanotube
Sensors



Pulsed Terahertz
Imaging



QUEST

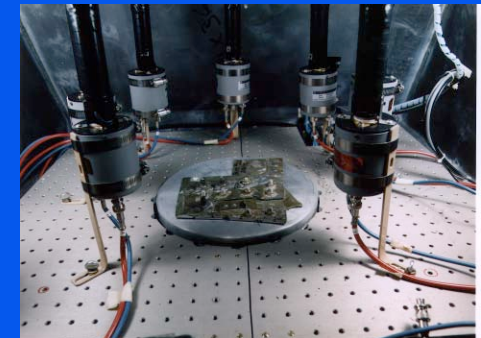
(Computed X-ray Tomography with Loading)

Nondestructive Evaluation Sciences Major Activities

Ultrasonic Scanning



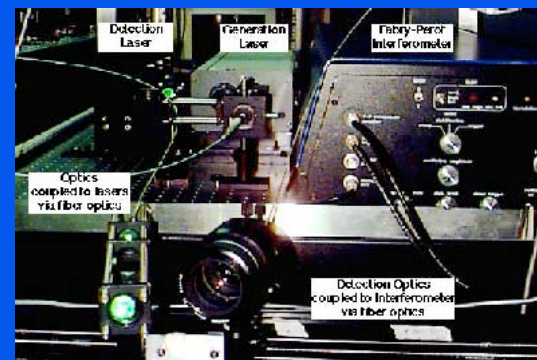
Reverse Geometry X-ray



Fiber Optic Sensors



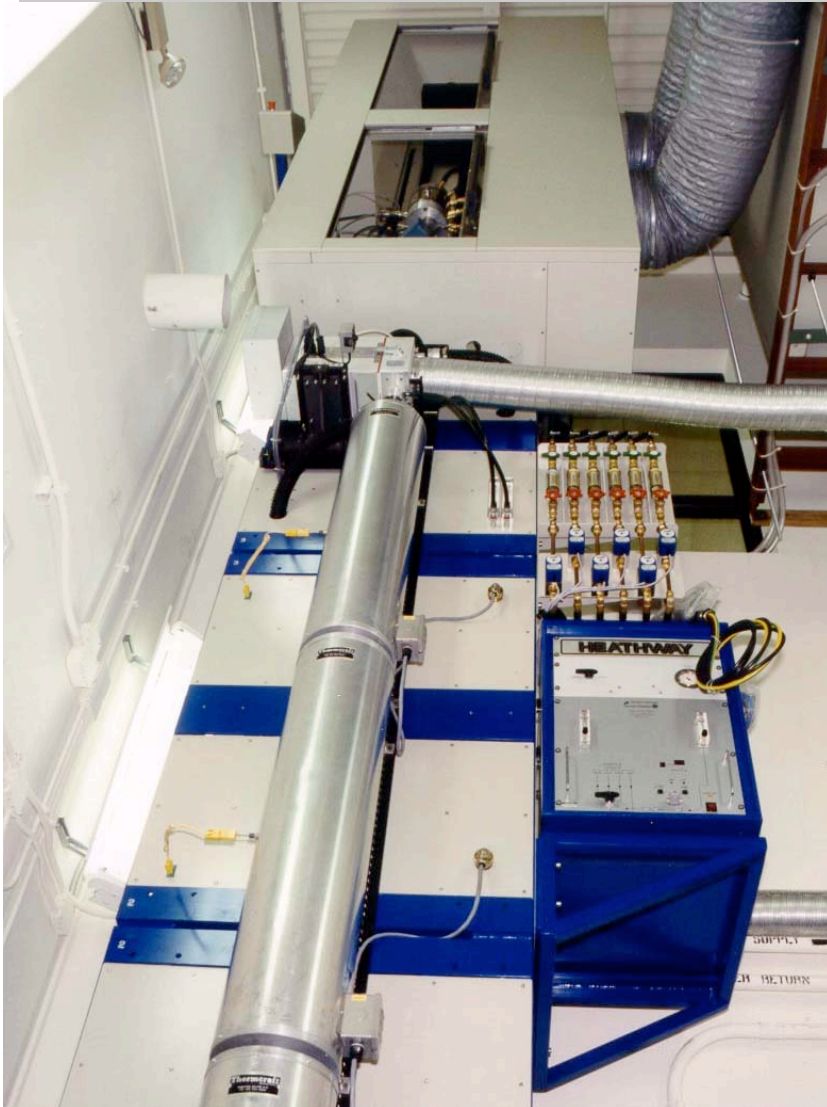
Laser Ultrasonics



Electromagnetics

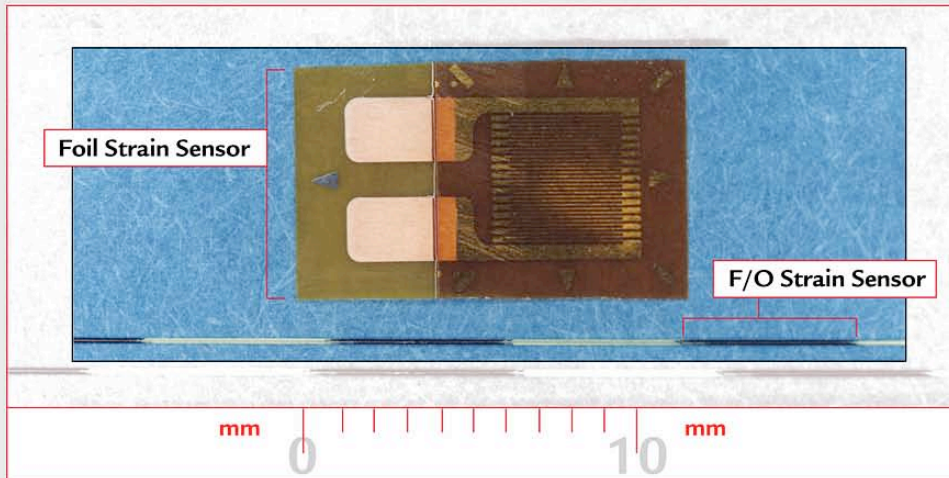


LaRC F/O DRAWTOWER



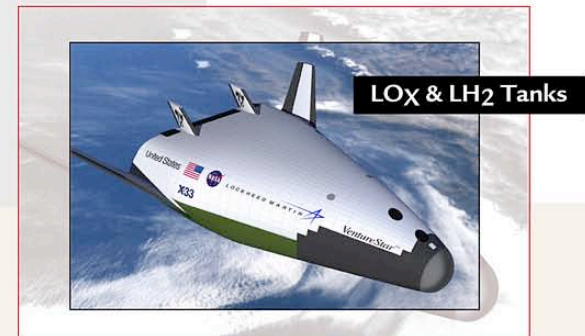
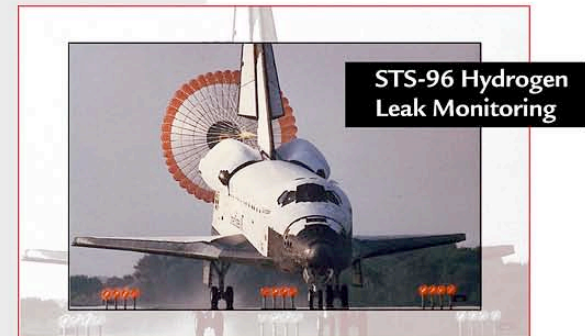
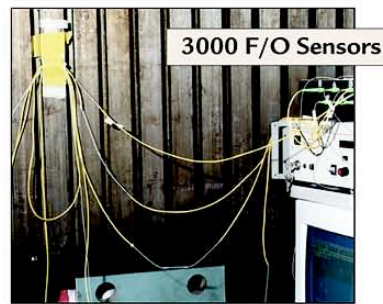
- On line sensor (grating) production
 - Custom sensor positioning
 - Increased sensor density
 - Improved fiber strength as compared to stripped/recoated fiber sensors
- Research capabilities
 - Specialty glasses and coatings
 - Fiber diameter variations
- Applications to date
 - X-33 sensors
 - Shuttle sensors
 - F-18 flight sensors
 - LaRC in-house structural test articles

Distributed Fiber-Optic (F/O) Sensing for Structures IVHM



High Density Structural Sensors

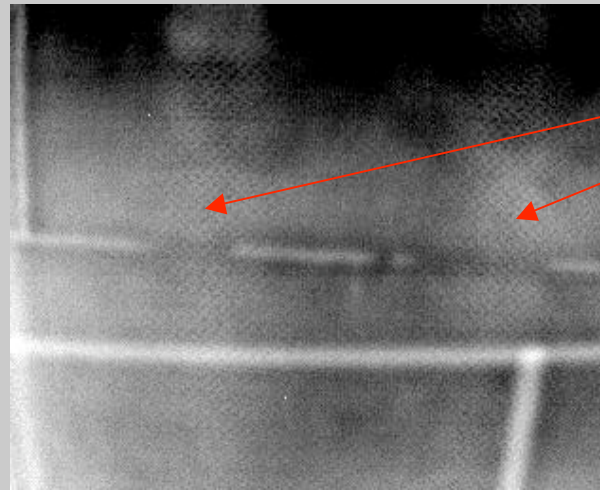
- 10,000 Sensors < 1 pound
- Strain, Temperature, & Hydrogen (Propellant Leaks)
- Future Research - Vibration, Shape, Acoustic Emission, Chemistry (Corrosion)
- < \$10/Sensor



Advanced Thermographic NDE



Wing Leading Edge
Thermographic
Inspection System

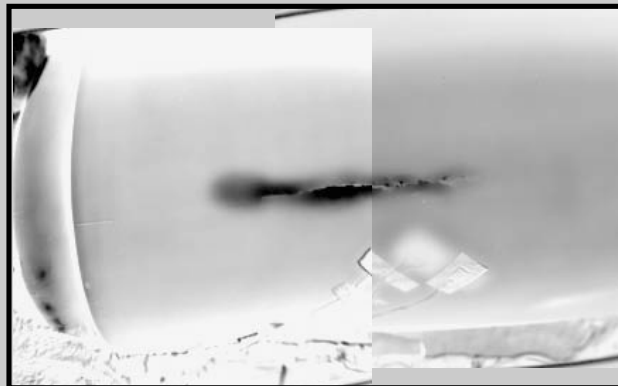


X-37

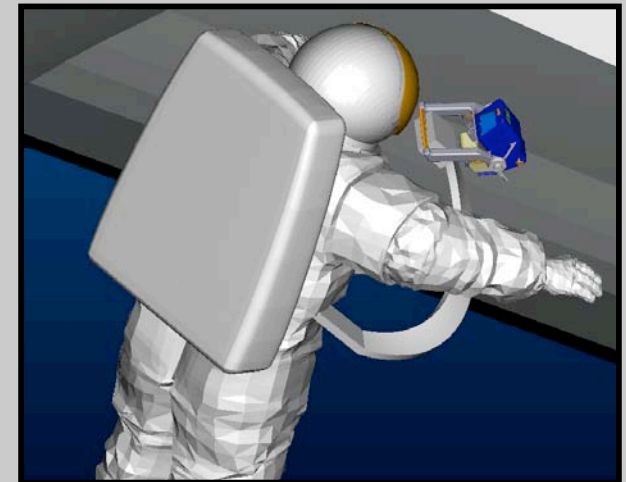
Indications of
disbonding



Thermography NDE support of
impact testing at Southwest
Research Institute (SWRI)

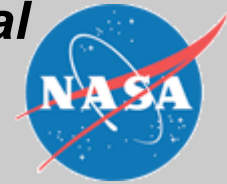


Thermography on an
RCC panel



Science Base for EVA IR
Camera

Terahertz Imaging of Flaws in Foam on the External Tank

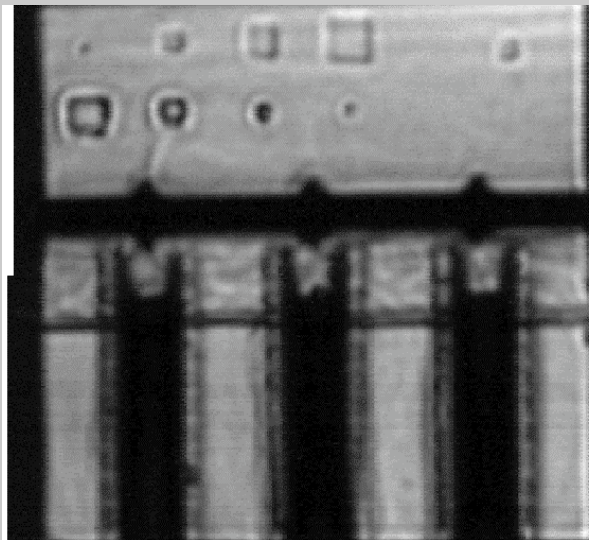


SOFI on the external tank near the intertank regions

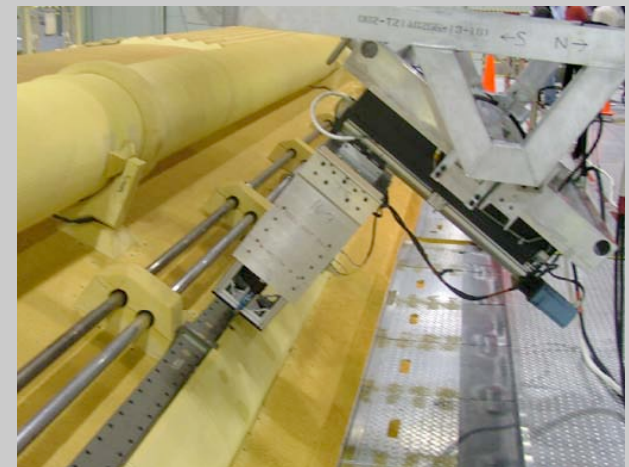
Implementation of a terahertz imaging system for detecting flaws in the external tank's foam



PAL ramp SOFI test panel



Terahertz image from a SOFI test panel



System implemented at Michoud for PAL ramp inspection

Summary



- >25 years R&D of a Broad Range of NDE Technologies for Advanced Aerospace Applications
- Proof of Concept => Field => Integrated NDE Systems